

# Technical News Bulletin

of the  
National Bureau of Standards

★ Issued Monthly ★

JAN 25 1945

Washington

December 1944<sup>1</sup>

Number 332

## CONTENTS

	Page		Page
New rubber laboratory in the Amazon valley.....	89	Painting of structural steel.....	91
Analysis of butadiene and styrene by mass spectrometer.....	90	Colorblindness tests.....	92
Preparing refractory oxides, silicates, and ceramic materials for analysis.....	90	Shrink-resistant wool socks.....	92
Gage for measuring vapor pressures of corrosive liquids.....	90	New and revised publications issued during November 1944.....	92
Hydrated calcium silicoaluminates.....	90	Mimeographed material: Letter Circulars.....	93
Heat of formation of carbon dioxide.....	91	Recent articles by members of the Bureau's staff published in outside journals.....	93
Heats of combustion of benzoic acid and graphite.....	91	Index to Technical News Bulletin 1944, Numbers 321 to 332, inclusive.....	94
Commercial standard for solid-fuel-burning forced-air furnaces.....	91		

### NEW RUBBER LABORATORY IN THE AMAZON VALLEY

Norman Bekkedahl, of the Bureau's rubber section, has just returned to Washington after spending 2 years in Brazil. In 1942, at the request of the Brazilian Government, the Bureau loaned the services of Dr. Bekkedahl to direct the establishment of a modern rubber laboratory at the Instituto Agronomico do Norte located in Belem in the State of Para (Technical News Bulletins 308, 316, and 321). He reports that the laboratory is now completely equipped and in operation, while its staff continues to be built up. Dr. Bekkedahl was assisted in this work by Fredrick L. Downs, one-time member of the Bureau staff and later an employee of the American Steel & Wire Co., Worcester, Mass., which granted him a leave of absence.

The Instituto Agronomico do Norte is one of several research institutes supported by the Brazilian Government and is somewhat similar to the Regional Research Laboratories of the United States Department of Agriculture. Dr. Felisberto Cardoso de Camargo, the director of the Instituto, has concentrated the research program largely on rubber, since it is the most important export of

the Amazon region. The location of the Instituto at Belem is particularly fortunate, since all the rubber from the Amazon valley passes through this port at the mouth of the river. Whatever the relative positions of natural and synthetic rubber in the post-war years, the Amazon Valley must be considered as one of the more important potential sources of natural rubber.

The fact that Belem is a seaport and an important stop on South American and trans-Atlantic airlines also has made it possible for the Instituto to operate a so-called "factory" located in the jungle about 5 miles from the Instituto. Here about 100 liters of rubber latex are collected each day from wild trees and processed into raw rubber sheets.

A wide variety of types of trees, other than the common rubber tree (*Hevea Brasiliensis*) are under investigation. Studies of different methods of coagulation can be made under various typically primitive conditions. The rubber that is not used in experiments is sold through normal commercial channels.

Plans are being made for continued cooperation between the new laboratory and the National Bureau of Standards and other organizations in the United States for the development of improved

<sup>1</sup> Published with approval of the Director of the Budget.

methods of testing and grading natural rubber, and for fundamental research on rubber of different origin and treatment.

#### ANALYSIS OF BUTADIENE AND STYRENE BY MASS SPECTROMETER

The Consolidated Engineering Corporation's mass spectrometer, recently installed at the Bureau, is being employed by A. Keith Brewer in analyses of liquid and gaseous materials for making synthetic rubber. This is an elaborate and highly specialized instrument that makes possible a quick, complete, and accurate analysis of samples of butadiene, styrene, and other monomers submitted by plant operators through the Rubber Reserve Co. Since many of the constituents are closely related hydrocarbons, the analyses by conventional methods would be impossible, or at least would involve considerable research on the method to be applied to each constituent. Studies are likewise being made of the purity of butadiene and styrene produced in different plants and by different methods. Other projects deal with the composition of recycled butadiene and styrene, which are recovered after polymerization for use in a later run. Such studies furnish information regarding the amount and kind of purification necessary for these materials. Analyses of vent gases have led to the conclusion that considerable amounts of valuable materials were being allowed to escape, and steps have been taken to reduce or eliminate the waste.

#### PREPARING REFRACTORY OXIDES, SILICATES, AND CERAMIC MATERIALS FOR ANALYSIS

As an outgrowth of work in preparing refractory platinum-metal alloys for analysis by treatment with acid mixtures at high temperatures, it has been found that numerous other substances that have caused trouble for the analyst will respond to a similar method of treatment. Aluminum oxide, beryllium oxide, tin oxide, cerium oxide, and thorium oxide, all of which are very resistant to the usual methods of chemical treatment if they have been ignited at high temperatures, dissolve rather readily in hydrochloric acid at temperatures ranging from 200° to 300° C. The treatment is applied in sealed glass tubes enclosed in steel pressure vessels charged with compressed carbon dioxide

in sufficient amounts to keep the glass tubes from bursting under the high pressures developed by the acid (TNB331, November 1944).

Most aluminum-bearing minerals, as well as a variety of other minerals and ceramic materials, can be decomposed, preparatory to analysis, by this treatment. The work is reported by Edward Wichers, William G. Schlecht, and Charles L. Gordon in the December number of the Journal of Research (RP1621).

#### GAGE FOR MEASURING VAPOR PRESSURES OF CORROSIVE LIQUIDS

The experimental work reported in TNB331 (November 1944) on the use of hydrochloric acid and other acid mixtures at temperatures up to 300° C to prepare for analysis refractory platinum-metal alloys and numerous refractory oxides, ceramic materials, and minerals, has necessarily involved the development of suitable laboratory techniques for conducting the new method of treatment. It was also necessary to measure the high pressures developed by the acid mixtures under the conditions of operation. In RP1622 in the December number of the Journal of Research, Charles L. Gordon, William G. Schlecht, and Edward Wichers describe an all-glass gage, with auxiliary equipment, suitable for the approximate measurement of the vapor-pressures of corrosive liquids. They report the pressures developed by various strengths of hydrochloric acid and its mixtures with nitric acid or perchloric acid at temperatures up to 300° C. The observed pressures ranged up to 4,000 lb/in<sup>2</sup>.

The paper describes how to construct, fill, and seal the glass tubes used as reaction vessels, and how to construct and use a simple steel pressure vessel to prevent the glass tubes from bursting. Carbon dioxide, added in solid form (dry ice) furnishes the compensating pressure. Information is also given on the proper amounts of carbon dioxide to compensate for the pressures developed within the sealed tubes by the various acid mixtures used.

#### HYDRATED CALCIUM SILICO-ALUMINATES

Following the discovery of the garnet-hydrogarnet series of compounds (J. Research NBS 26, 13 (January 1941) RP1355), an investigation was begun of other complex calcium aluminate salts which may be constituents of hydrated portland cement. In the Journal of Re-

search for December (RP1623), E. P. Flint and Lansing S. Wells describe the preparation of three new complex hydrated aluminates, as follows: (1) A low-silica calcium silicoaluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{CaSiO}_3 \cdot 12\text{H}_2\text{O}$ ; (2) a high-silica calcium silicoaluminate of probable formula,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{CaSiO}_3 \cdot 30-32\text{H}_2\text{O}$ ; and (3) a hexacalcium aluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{Ca}(\text{OH})_2 \cdot 30\text{H}_2\text{O}$ .

The first of these compounds is closely related to the low-sulfate calcium sulfoaluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{CaSO}_4 \cdot 12\text{H}_2\text{O}$ , which may be formed during the setting of portland cement. The other two compounds are very similar to the high-sulfate calcium sulfoaluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{CaSO}_4 \cdot 31\text{H}_2\text{O}$ , which is known to be a constituent of hydrated portland cement. Crystals of the high-silica silicoaluminate were identified in mixtures of the following cement compounds which had stood in contact with approximately saturated lime solution for 3 years:  $\beta\text{-}2\text{CaO} \cdot \text{SiO}_2$  and  $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ ,  $\beta\text{-}2\text{CaO} \cdot \text{SiO}_2$  and  $3\text{CaO} \cdot \text{Al}_2\text{O}_3$ , and  $3\text{CaO} \cdot \text{SiO}_2$  and  $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ . The low-silica silicoaluminate, on standing in contact with lime solution, is slowly transformed to the high-silica compound, and this behavior is analogous to that of the two forms of calcium sulfoaluminate.

The hydrated hexacalcium aluminate,  $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 3\text{Ca}(\text{OH})_2 \cdot 30\text{H}_2\text{O}$ , probably does not occur as a direct hydration product of portland cement but might form, under certain conditions, as a solid solution in the high-sulfate form of calcium sulfoaluminate.

#### HEAT OF FORMATION OF CARBON DIOXIDE

In the Journal of Research for December (RP1620), Edward J. Prosen, Ralph S. Jessup, and Frederick D. Rossini present a recalculation of data previously reported on the heats of combustion of graphite and diamond (TNB258, October 1938), together with some new data on graphite. As a result of this recent work, certain "best" values have been selected as representing the heats of combustion of graphite and diamond and the transition of graphite into diamond:

$\text{C(c, graphite)} + \text{O}_2(\text{gas}) = \text{CO}_2(\text{gas}); \Delta H^\circ_{298.15} = -393,447 \pm 45 \text{ int. j/mole} = -94,051.8 \pm 10.8 \text{ cal/mole.}$

$\text{C(c, diamond)} + \text{O}_2(\text{gas}) = \text{CO}_2(\text{gas}); \Delta H^\circ_{298.15} = -395,343 \pm 96 \text{ int. j/mole} = -94,505.1 \pm 22.9 \text{ cal/mole.}$

$\text{C(c, graphite)} = \text{C(c, diamond)}; \Delta H^\circ_{298.15} = 1896 \pm 85 \text{ int. j/mole} = 453.2 \pm 20.3 \text{ cal/mole.}$

#### HEATS OF COMBUSTION OF BENZOIC ACID AND GRAPHITE

Experimental data on the heats of combustion of benzoic acid and carbon in the form of graphite are presented by Edward J. Prosen and Frederick D. Rossini in the December Journal of Research (RP1619). The data on benzoic acid support the change in the value of its heat of combustion reported by Jessup two years ago (TNB306, October 1942). The data on graphite yield a slightly higher value for the heat of formation of carbon dioxide than that previously reported.

#### COMMERCIAL STANDARD FOR SOLID-FUEL-BURNING FORCED- AIR FURNACES

Commercial Standard CS109-44, now available in printed form is a recorded voluntary standard of the trade for solid-fuel-burning forced-air furnaces. It was developed by the industry in cooperation with the Government, on request of the Federal Housing Administration. The standard sets forth definitions, requirements for construction, performance under test, test code, informative labeling, and a uniform manufacturer's guarantee declaring the maximum and minimum output obtainable according to the commercial standard.

The standard will provide uniform methods of testing and rating, a Nationally recognized basis for guaranteeing performance and output, and will constitute a basis for fair competition. It became effective for new production on March 10, 1944.

Copies of CS109-44 are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 10 cents each.

#### PAINTING OF STRUCTURAL STEEL

Building Materials and Structures Report BMS102, recently released, gives the results of tests on a large number of priming and finish coat paints of various types to determine their durability and the degree of protection afforded to structural steel. This project, under the direction of Wilbur C. Porter, made use of accelerated laboratory and outdoor exposure tests. The primings were applied to treated and untreated steel and galvanized iron panels. The effect of improving the protective value of primings by various pretreatment processes was given special consideration.

The composition of the paints and the relative ratings, based on their performance in these tests, are discussed in detail. Many paints were found suitable for use in protecting metal structures. Zinc chromate and iron oxide-zinc chromate primings, when properly formulated with a synthetic resin vehicle, make very good rust-inhibitive coatings. They combine to a high degree the essential requirements necessary to withstand extremely severe corrosive atmospheres. The zinc dust paints, particularly the alkyd type, have good adhesion on galvanized iron. Among the topcoat finishes tested, aluminum, black, and dark-colored paints were the most durable.

This is the third and final report covering the investigation of surface treatment for corrosion protection of steel members for low-cost housing construction. Copies of BMS102 are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. The price is 10 cents.

#### COLORBLINDNESS TESTS

Through the committees of the Inter-Society Color Council, the Bureau has cooperated with the Army Air Forces, the U. S. Submarine Base at New London, and the Bureau of Medicine and Surgery, in trials and revisions of established tests of color vision and in the design of new tests. The purpose of this work is to assist the Navy and War Departments in their efforts to make sure that men with defective color vision are not placed where this defect would be a handicap.

About 2 percent of otherwise normal males lack the ability to distinguish red-green differences, and to about half of this 2 percent, red signals not only fail to appear red but also have less than one-fifth normal brightness. Such observers are known as protanopes to distinguish them from other red-green-blind observers, to whom red signals are normally bright, known as deuteranopes. It has been found possible to express the quantitative data on the color confusions of protanopic and deuteranopic observers, obtained by Pitt a few years ago in Great Britain, in terms of the ICI standard observer for colorimetry.

The derivation of the functions defining the color confusions of average red-green-blind observers is given in RP1618, Standard Response Functions for Protanopic and Deuteranopic Vision, by Deane B. Judd, in the December number of the Journal of Research. These functions have been useful in analyzing the performance of established tests for

color vision and in the design of new tests. This use of the functions is exemplified by the solution of three problems arising in design of colorblindness tests, and comparisons of these solutions are made with experimental results. It is pointed out that these functions accord with the form of three-components theory of color vision worked out in 1897 by Arthur König, and with the dominator-modulator form of that theory suggested in 1943 by Granit. These functions do not, however, form the basis for a complete theory of color vision, such as that of G. E. Müller.

#### SHRINK-RESISTANT WOOL SOCKS

In order to increase the wear life of wool socks by decreasing shrinkage during laundry, the Quartermaster Corps requested that a project be initiated to study shrinkproofing methods for wool fabrics and knit goods. There was considerable difference of opinion as to the effect on wool of existing shrinkproofing methods, and the problem was to develop a treatment or to ascertain which of the existing methods would combine adequate reduction in shrinkage with minimum damage to the wool, and which, at the same time, would be readily adaptable to mill production. The fundamental research on various types of treatments was carried out by the Research Associateship of the Textile Foundation, and the adaptability of these treatments to mill production was tested by making regular mill runs at a pilot plant established in a large hosiery mill. As a result of the work, it was found that a treatment using calcium hypochlorite at a given pH cuts the shrinkages down to about 5 percent and meets all other requirements satisfactorily. This is in contrast to about 20- to 25-percent shrinkage of the untreated socks under the same conditions. Comparative wear tests, conducted under field conditions of wear and laundry, show that socks so treated can be expected to have a 60 percent longer life than the untreated socks. At present the treatment is being used on 60 to 70 percent of all "socks, wool, cushion-sole," manufactured for the Army.

#### NEW AND REVISED PUBLICATIONS ISSUED DURING NOVEMBER 1944

##### Journal of Research<sup>2</sup>

Journal of Research of the National Bureau of Standards, volume 33, number 3, September 1944 (RP1602 to RP1605,

inclusive). Price 30 cents. Annual subscription, 12 issues, \$3.50.

**Research Papers<sup>2</sup>**

[Reprints from the September 1944 Journal of Research]

RP1602. Soil-corrosion studies, 1941: Ferrous and nonferrous corrosion-resistant materials and nonbituminous coatings. Kirk H. Logan and Melvin Romanoff. Price 20 cents.

RP1603. Revised results obtained with certain dehydrating agents used for drying gases. John H. Bower. Price 5 cents.

RP1605. Transformation of the fundamental equations of thermodynamics. Floyd Buckley. Price 10 cents.

**Building Materials and Structures Reports<sup>2</sup>**

BMS102. Painting steel. Wilbur C. Porter. Price 10 cents.

**Simplified Practice Recommendations<sup>2</sup>**

R6-44. Files and rasps (American pattern, and straight- and curved-tooth milled files). (Supersedes R6-42.) Price 10 cents.

**Commercial Standards<sup>2</sup>**

CS109-44. Solid-fuel-burning forced-air furnaces. Price 10 cents.

<sup>2</sup> Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, \$3.50 a year (to addresses in the United States and its possessions and to countries extending the franking privilege); other countries, 70 cents and \$4.50, respectively.

**Technical News Bulletin<sup>2</sup>**

Technical News Bulletin 331, November 1944. Price 5 cents. Annual subscription, 50 cents.

**MIMEOGRAPHED MATERIAL**

**LETTER CIRCULARS**

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC767. Inorganic analytical chemistry: Publications by members of the staff of the National Bureau of Standards. (Supersedes LC675.)

LC770. Expanded table of weights per United States gallon and weights per cubic foot of sugar (sucrose) solutions at 20° C. Carl F. Snyder and Lester D. Hammond.

**RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS<sup>2</sup>**

The 6×42 binocular. Lieut. W. R. Bailey and G. M. Kline. Modern Plastics (122 East 42d Street, New York 17, N. Y.) 22, 105 (October 1944).

"Hotter than hell," not accurate measure of temperature. George D. Miller. The Taylor Meteor (Taylor Instrument Cos., Rochester 1, N. Y.) 8 No. 8, 2 (October 1944).

<sup>2</sup> These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.



# INDEX TO TECHNICAL NEWS BULLETIN 1944, NUMBERS 321 TO 332, INCLUSIVE

	Page		Page
<b>A</b>		Building code standard, development.....	43
Acheson medal and prize awarded to William Blum.....	71	Building codes of the future.....	43
Acid potassium phthalate, pH of.....	36	Building codes, place of, in urban development.....	5
Adsorbents, solid, bibliography.....	68	Butadiene, analysis by mass spectrometer.....	90
Aggregate constituents, reactivity, in alkaline solutions.....	52	Butadiene, liquid densities.....	2
Aggregates, concrete, thermal expansion.....	19	Butadiene, thermodynamic properties of <i>cis</i> -butene-2.....	51
Airworthiness of fabrics, instrument for determining.....	67	Butene-2, <i>cis</i> , thermodynamic properties.....	51
Alcohol as an engine fuel.....	82	<b>C</b>	
Alkali etching test on concrete aggregates.....	4	Capacitance, apparent, of radio components.....	13
Alkaline solutions, reactivity of aggregate constituents.....	52	Carbohydrate field, reactions in.....	13
Alloys, light, cohesive strength at low temperatures.....	54	Carbon, activated, bibliography.....	68
Altitude determination by measurement of air pressure and temperature.....	81	Carbon dioxide, heat of formation.....	91
Amazon valley, new rubber laboratory in.....	80	Carbon, macoanalysis.....	20
American Society for Testing Materials, P. H. Bates elected president.....	62	Cast Iron Pipe Research Association, cooperation with.....	67
Amylases, hydrolysis of starches by, in the presence and absence of yeasts.....	60	Cement clinker, manner of combination with sodium oxide in.....	5
Analysis, preparing refractory oxides, silicates, and ceramic materials for.....	90	Cements, commercial vinsol resin.....	75
Antiscatter treatments for glass.....	74	Ceramic materials, preparation for analysis.....	90
Army buildings, temporary, exterior paint on.....	82	Charts, loading, for transmission lines.....	79
Aromatic hydrocarbons, analytical determination by adsorption.....	26	Chimneys for low-cost houses, temperatures developed in.....	62
Aromatic hydrocarbons, separation and recovery from naphthenes.....	27	Citrus products, preparation of sodium strontium galacturonate from.....	85
Assistant to the Director, Ralph W. Smith appointed.....	38	Clay products section, death of R. T. Stull.....	14
<b>B</b>		Code, building, standard, development.....	43
Barometer for measuring altitude.....	81	Codes, building, of the future.....	42
Bates, P. H., elected president of American Society for Testing Materials.....	62	Codes, building, place of, in urban development.....	5
Batteries, dry, raw materials.....	69	Coefficients of expansion of the hydrocarbons.....	28
Batteries, dry, output of over-age.....	33	Cohesive strength of some steels and light alloys at low temperatures.....	54
Beet pulp, as source of galacturonic acid.....	85	Color and tinting strength of paint pigments, standards for.....	83
Bekkedahl, Norman, returns from Brazil.....	89	Colorblindness tests.....	92
Benzic acid, heat of combustion.....	91	Columbia University confers doctorate of science on Lyman J. Briggs.....	63
Bessel functions for complex arguments.....	23	Commercial standards:	
Binooculars, plastic.....	74	bituminized-fibre drain and sewer pipe.....	42
Bituminized fibre drain and sewer pipe, commercial standard.....	42	earthenware (vitreous glazed) plumbing fixtures.....	5
Blankets, household, properties.....	43	hospital sheeting.....	37
Blum, William, receives Acheson medal and prize.....	71	jewelry, silver, marking.....	71
Bolometer-thermocouple, test of a.....	83	mineral wool insulation.....	61
Bonding of metals with plastics.....	11	oil-burning floor furnaces.....	38
Bone char, bibliography.....	68	solid-fuel-burning forced-air furnaces.....	91
Boric acid, ionization constant.....	77	testing textiles.....	60
Brazilian rubber laboratory, natural and synthetic rubber.....	2	tire repairs by vulcanization.....	21
Bridge-cable wire, stress-corrosion tests.....	66	underwear, knit.....	29
Briggs, Lyman J., receives doctorate of science from Columbia University.....	63	Compressibility of fabrics.....	29
Broadcast, standard frequency.....	18	Concrete aggregates, alkali etching test.....	4
Bronze, effect of, on marble.....	19	Concrete aggregates, thermal expansion.....	19
Buffer mixtures, effect of sodium chloride.....	26	Concrete, permeability to kerosine.....	35, 52
Buffers as spectral filters for the ultraviolet.....	20	Concrete, reinforcement for anchorages in.....	67
Building code requirements for masonry.....	29	Conference of State utility commission engineers, 22d annual.....	54
Building code requirements, recommended, for dwelling construction.....	93	Cordage fibers, machines and methods for testing.....	75
		Corrosion, soil, of pipe lines.....	66
		Corrosion test, salt spray, standardization.....	53
		Corrosive liquids, vapor pressures, gage for measuring.....	90
		Cotton harnesses for horses.....	29
		Crystalline structure of mica, anomalies in.....	13

32,

Page

43

43

5

90

2

51

51

13

13

68

91

20

67

5

75

90

79

62

85

14

43

42

5

37

71

61

38

91

60

10

21

29

4

19

52

67

54

75

66

53

90

29

13

D

Densities, liquid, of hydrocarbons.....	2
Density of tanning extracts.....	86
Diamond, heat of combustion.....	91
Dicalcium silicate solutions.....	5
Differentiation, numerical, coefficients, with central differences, table.....	30
Dipole moment and structure of trioxane.....	52
Discussion of safety rules for electrical supply and communication lines.....	78
Dispersion of optical glass.....	4
Dispersion of optical glass, determination by immersion.....	9
Distilled water system, laboratory.....	12
Distilling columns, laboratory, reflux regulator and head.....	84
Dopes for automobile fuels.....	26
Driers, metallic, influence on linseed-replacement oils.....	35
Dry batteries, over-age, output.....	33
Dry cells and their raw materials.....	69
Drying agents, commercial, efficiency.....	69

E

"E" award, fourth renewal.....	17
Electrical units, absolute, review of recent determinations.....	78
Electrodes, platinum and palladium hydrogen, comparison, in aqueous solutions of acid potassium phthalate.....	59
Emulsions, oil in water, turbidimetric standards and tests of turbidimeters.....	25
Entropy and specific heat of synthetic rubber, GR-S.....	51
Equations, fundamental, of thermodynamics, transformations of.....	76
Expansion of tanning extracts.....	86
Exposure tests, long-time, of metals.....	58

F

Fabrics, airworthiness, instrument for determining.....	67
Fabrics, coated, gas permeability.....	57
Fabrics, compressibility and resilience.....	29
Fabrics, moist, thermal properties.....	34
Fibers, cordage, machines and methods for testing.....	75
Filter paper, speed.....	87
Filters, spectral, for the ultraviolet, use of buffers as.....	20
Fire hazards of paints on metals.....	52
Flow, laminar, at the interface of two liquids.....	44
Flow nozzles, critical, calibration for Heat Exchange Institute.....	76
Flowmeter for oxygen regulator test sets.....	68
Fourier coefficients.....	30
Freezing and melting curves of hydrocarbons.....	36
Freezing points of hydrocarbons.....	35
Freezing, slow fractional, for purifying substances.....	44
Frequency standard broadcast.....	18
Fuel, engine, alcohol as.....	82
Fuel oil, domestic, how to save.....	3
Fuels, automobile, dopes for.....	26
Furnaces, oil burning floor, commercial standard.....	38
Furnace, solid-fuel-burning forced air, commercial standard.....	91

G

Gage for measuring vapor pressure of corrosive liquids.....	90
Galacturonate, sodium strontium, preparation from citrus products.....	85
Galacturonic acid, salts of.....	20
Galacturonic acid, salts of, preparation from beet pulp.....	85
Galvanized steel, weathering losses.....	12
Gas permeability of coated fabrics.....	57
Gasoline fraction of petroleum, hydrocarbons in.....	2
Generator, surge current.....	17

Page

Glass, antiscatter treatments for.....	74
Glass, optical, index of refraction by immersion.....	9
Glass, optical, refractivity.....	4
Grade terminology problem, the.....	38
Graphite, heat of combustion.....	91
GR-S, synthetic rubber, stress temperature relations.....	86
GR-S, synthetic rubber, specific heat and entropy.....	51

H

Hardness tester, indentation.....	9
Harnesses, cotton, for horses.....	29
Hearing aids, properties.....	50
Heat Exchange Institute, calibration of critical flow nozzles.....	76
Heats of combustion of benzoic acid in graphite.....	91
Heats of combustion of paraffin hydrocarbons.....	77
Hosiery, shrinkage, an aid to the measurement of.....	33
Hosiery, wool, shrink-resistant.....	92
Hospital sheeting for mattress protection, commercial standard.....	37
Humidity, effect on physical properties of paper.....	34
Hydrated calcium silicoaluminates.....	90
Hydrocarbons:	
aromatic, separation and recovery from naphthenes by adsorption.....	27
aromatic, analytical determination by adsorption.....	26
coefficients of expansion.....	28
determining individual, in mixtures.....	35
freezing and melting curves.....	36
in the gasoline fraction of petroleum.....	2
liquid densities.....	2
paraffin, heats of combustion.....	77
standard samples.....	27
Hydrogen, macro analysis.....	20
Hydrolysis of starches by analyses in the presence and absence of yeast.....	60

I

Ignition, self-, of woolen materials.....	43
Ignition temperatures of liquids.....	70
Impurities in organic solvents, spectrophotometric method for detecting.....	37
Incombustible material, definition.....	82
Indentation hardness tester.....	9
Insulation, mineral wool, commercial standard.....	61
Interferometer measurements of the expansion of iron.....	58
Interpolation, inverse, with central differences, table of coefficients.....	30
Ionization constant of boric acid.....	77
Iridium, bringing it into solution.....	84
Iron, cast, high silicon, thermal expansion.....	28
Iron, interferometer measurements of expansion.....	58

J

Jewelry, silver, commercial standard for marking.....	71
---	----

K

Kerosine, permeability of concrete to.....	35, 52
--	--------

L

Lagrangian integration formulas, seven-point table.....	30
Laminar flow at the interface of two liquids.....	44
Leather, sole, effect of oil and wax treatments.....	1
Length standards, recomparison.....	41
Lines, electric supply and communication, discussion of safety rules.....	78
Lines, electric supply and communication, loading charts.....	79
Linseed-replacement oils, influence of metallic driers.....	35

	Page		Page
Liquid junction potentials.....	77	Paper stock and shipping tags.....	3
Liquids, self-ignition, temperatures.....	70	Paper, wet strength, for war maps.....	73
List of publications, change in price.....	46	Parsons, D. E., assistant chief of clay and silicate products division.....	14
List of publications, revised supplementary.....	22	Pectic substances, synthesis of vitamin C from.....	51
Logan, Kirk H., becomes research associate of Cast Iron Pipe Research Association.....	67	Permanent magnets.....	84
Looking glass, plastics through the.....	49	Permeability of coated fabrics to gases.....	57
Low-cost houses, temperatures developed in chimneys.....	62	Permeability of concrete to kerosene.....	35
Low temperatures, technical cohesive strength of some steels and light alloys at.....	54	Petroleum, hydrocarbons in the gasoline fraction.....	2
<b>M</b>		pH of acid potassium phthalate.....	36
Machines, testing, for cordage fibres.....	75	Photometry, photocell, zero resistant circuit for.....	18
Macro analysis of carbon and hydrogen.....	20	Plenkowsky, A. T., retires.....	14
Macurdy, L. B., acting chief of mass section.....	14	Pipe, drain and sewer, bituminized fibre, commercial standard.....	42
Magnets, permanent.....	84	Pipe lines, soil corrosion.....	66
Maps, war, wet-strength paper for.....	73	Plastic binoculars.....	74
Marble, effect of bronze on.....	19	Plastics for bonding metals.....	11
Masonry, building code requirements.....	29	Plastics through the looking glass.....	40
Mass section, A. T. Plenkowsky retires as chief, L. B. Macurdy becomes acting chief.....	14	Platiniferous materials, bringing them into solution.....	84
Mass spectrometer for analyzing butadiene and styrene.....	90	Platinum and palladium hydrogen electrodes, comparison, in aqueous solutions of potassium phthalate.....	59
Mathematical tables, new.....	23, 30, 71	Plumbing fixtures, earthenware, (vitreous-glazed), commercial standard.....	5
Mechanical properties of metals and alloys, new circular.....	22	Potassium phthalate, acid, pH.....	36
Medal, Acheson, and prize, awarded to William Blum.....	71	Potassium phthalate, acid, aqueous solutions, comparison of platinum and palladium hydrogen electrodes.....	59
Melting and freezing curves of hydrocarbons.....	36	Potentials, liquid junction.....	77
Metallurgy, powder.....	65	Powder metallurgy.....	65
Metals and alloys, mechanical properties, new Circular.....	22	Power factor of radio components.....	13
Metals, long-time exposure test.....	58	Printing plates, bonding with plastics.....	11
Mica, anomalies in crystalline structure.....	13	Publications, list, change in price.....	46
Mineral wool insulation, commercial standard.....	61	Publications, list, revised supplementary.....	22
Mirrors, signaling.....	9	Pure substances, determination of residual water in.....	59
Moist fabrics, thermal properties.....	34	Purification of substances by slow fractional freezing.....	44
Molecular structure, optical rotation as indication of.....	60	<b>R</b>	
Mortars, refractory bonding, Federal specification.....	12	Radiation standards, maintenance.....	69
<b>N</b>		Radiation, ultraviolet solar and sky, a daily record.....	50
Nonferrous metals, determination of tin in.....	75	Radio broadcast, standard frequency.....	18
Nozzles, critical flow, calibration for Heat Exchange Institute.....	76	Radio components, power factor.....	13
<b>O</b>		Radiometric method of testing ultraviolet screening properties of sunburn preventive creams.....	41
Ohm, absolute determinations.....	78	Railway track scale testing service.....	13
Oil burning floor furnaces, commercial standard.....	38	Reciprocals, table, from 100,000 through 200,009.....	23
Oil, domestic fuel, how to save.....	8	Reflux regulator and head for laboratory distilling columns.....	84
Oil-in-water emulsions, turbidimetric standards and tests of turbidimeters.....	25	Refraction of optical glass, determination by immersion.....	9
Oil treatment of sole leather.....	1	Refractivity of optical glass.....	4
Oils, lined-replacement, influence of metallic driers.....	35	Refractory bonding mortars, Federal specifications.....	12
Optical glass, index of refraction by immersion.....	9	Refractory oxides, preparation for analysis.....	90
Optical glass, refractivity.....	4	Reinforcement in concrete, anchorages for.....	67
Optical rotation as an indication of molecular structure.....	60	Resilience of fabrics.....	29
Oxygen regulator test sets, flowmeter for.....	68	Response function for protanopic and deuteranopic vision.....	92
<b>P</b>		Rotation, optical, as an indication of molecular structure.....	60
Paint, exterior, on temporary buildings.....	82	Rubber for tire treads, wear resistance.....	10
Paint pigments, color and tinting strength, standard for.....	83	Rubber laboratory, new, in Amazon valley.....	89
Painting of structural steel.....	91	Rubber, natural and synthetic.....	2
Paints on metals, fire hazard.....	52	Rubber, natural, stress-temperature relations.....	86
Paper, effect of humidity on physical properties.....	34	Rubber, synthetic, GR-S, stress-temperature relations.....	86
Paper, filter, speed.....	87	Rubber, synthetic, GR-S, specific heat and entropy.....	51
Paper shipping sacks, Federal specification.....	22	<b>S</b>	
		Sacks, paper shipping, Federal specification.....	22
		Safety rules for electric supply and communication lines, discussion.....	78



	Page		Page
Salt spray corrosion test, standardization.....	53	Textile Research Institute.....	1, 50
Scale, railway track, testing service.....	18	Textures, testing, commercial standard.....	60
Scale substance of wool.....	21	Thermal expansion of concrete aggregates.....	19
Sheeting, hospital, for mattress protection, commercial standards.....	37	Thermal expansion of high silicon cast iron.....	28
Shrink resistant wool socks.....	92	Thermal expansion of iron, interferometer for measuring.....	58
Shrinkage of hosiery, an aid to the measurement.....	33	Thermal properties of moist fabrics.....	34
Signaling mirrors.....	9	Thermodynamic-bolometer, test of a.....	83
Silicates, preparation for analysis.....	90	Thermodynamics, transformations of fundamental equations.....	70
Silicoaluminates, hydrated calcium.....	90	Thomas, David E., retirement.....	30
Silver jewelry, marking, commercial standard.....	31	Tin, determination in nonferrous metals.....	75
Smith, Ralph W., appointed Assistant to the Director.....	92	Tinting strength and color of paint pigments, standards for.....	83
Socks, wool, shrink resistant.....	45	Tire repairs by vulcanization, commercial standard.....	10
Soda-lime-silica-water, quaternary system.....	26	Tire treads, wear of.....	30
Sodium chloride, effect on buffer mixtures.....	66	Transcendental equation, table of the first five zeros.....	10
Soil corrosion of pipe lines.....	53	Trioxane, dipole moment and structure.....	52
Solders and soldered joints, short time tests.....	1	Turbidimetric standards and tests for turbidimeter for oil in water emulsions.....	25
Sole leather, effect of oil and wax treatments.....	84		
Solution of platiniferous materials.....	37	<b>U</b>	
Solvents, organic, impurities in, spectrophotometric method for detecting.....	51	Ultraviolet filters, spectral, use of buffers for.....	20
Specific heat and entropy of synthetic rubber GR-S.....	22	Ultraviolet screening properties of sunburn preventive creams, radiometric method of testing.....	41
Specifications, Federal, for refractory bonding mortars.....	12	Ultraviolet solar and sky radiation, a daily record.....	50
Spectrometer, mass, for analyzing butadiene and styrene.....	90	Underwear, knit, commercial standard.....	21
Spectrophotometers.....	83	Utility commission engineers, State, 22d annual conference.....	54
Spectrophotometric method for detecting impurities in organic solvents.....	37		
Standard samples of hydrocarbons.....	27	<b>V</b>	
Standards of radiation, maintenance.....	69	Vapor pressures of corrosive liquids, gage for measuring.....	90
Starches, hydrolysis by amylases, in presence and absence of yeasts.....	60	Vinsol resin cements, commercial.....	75
State utility commission engineers, 22d annual conference.....	52	Viscosity of water.....	45
Steel, galvanized, weathering losses.....	14	Vitamin C, synthesis from pectic substances.....	51
Steel, structural, painted.....	91	Volt, absolute, review of recent determinations.....	78
Steels, technical cohesive strength at low temperatures.....	54	Vulcanization of tires, commercial standard.....	10
Stress-corrosion tests of bridge-cable wire.....	66		
Stull, Ray T., death of.....	14	<b>W</b>	
Styrene, analysis by mass spectrometer.....	90	Water, residual, determination in pure substances.....	59
Sunburn preventive creams, ultraviolet screening properties, radiometric method of testing.....	41	Water system, distilled, for laboratories.....	12
Surge current generator.....	17	Water, viscosity of.....	45
Synthetic rubber GR-S, specific heat and entropy.....	51	Wax treatment of sole leather.....	1
System, quaternary soda-lime-silica-water.....	45	Wear of tire treads.....	10
		Weathering losses of galvanized steel.....	12
<b>T</b>		Wire, bridge-cable, stress corrosion tests.....	66
Tables, mathematical, new.....	23, 30, 71	Wool, scale substance.....	21
Tags, paper, for stock and shipping purposes.....	3	Wool socks, shrink resistant.....	92
Tangents and cotangents, circular and hyperbolic, tables.....	23	Woolen materials, self-ignition.....	43
Tanning extracts, density and expansion.....	86	<b>Y</b>	
Temperatures developed in chimneys of low-cost houses.....	62	Yeasts, effect on hydrolisis of starches by amylases.....	60
Terminology, grade, the problem of.....	38		
Textile research at the Bureau.....	11	<b>Z</b>	
		Zero resistance circuit for photocell photometry.....	18

1	1891	1891	1891
2	1892	1892	1892
3	1893	1893	1893
4	1894	1894	1894
5	1895	1895	1895
6	1896	1896	1896
7	1897	1897	1897
8	1898	1898	1898
9	1899	1899	1899
10	1900	1900	1900
11	1901	1901	1901
12	1902	1902	1902
13	1903	1903	1903
14	1904	1904	1904
15	1905	1905	1905
16	1906	1906	1906
17	1907	1907	1907
18	1908	1908	1908
19	1909	1909	1909
20	1910	1910	1910
21	1911	1911	1911
22	1912	1912	1912
23	1913	1913	1913
24	1914	1914	1914
25	1915	1915	1915
26	1916	1916	1916
27	1917	1917	1917
28	1918	1918	1918
29	1919	1919	1919
30	1920	1920	1920
31	1921	1921	1921
32	1922	1922	1922
33	1923	1923	1923
34	1924	1924	1924
35	1925	1925	1925
36	1926	1926	1926
37	1927	1927	1927
38	1928	1928	1928
39	1929	1929	1929
40	1930	1930	1930
41	1931	1931	1931
42	1932	1932	1932
43	1933	1933	1933
44	1934	1934	1934
45	1935	1935	1935
46	1936	1936	1936
47	1937	1937	1937
48	1938	1938	1938
49	1939	1939	1939
50	1940	1940	1940
51	1941	1941	1941
52	1942	1942	1942
53	1943	1943	1943
54	1944	1944	1944
55	1945	1945	1945
56	1946	1946	1946
57	1947	1947	1947
58	1948	1948	1948
59	1949	1949	1949
60	1950	1950	1950
61	1951	1951	1951
62	1952	1952	1952
63	1953	1953	1953
64	1954	1954	1954
65	1955	1955	1955
66	1956	1956	1956
67	1957	1957	1957
68	1958	1958	1958
69	1959	1959	1959
70	1960	1960	1960
71	1961	1961	1961
72	1962	1962	1962
73	1963	1963	1963
74	1964	1964	1964
75	1965	1965	1965
76	1966	1966	1966
77	1967	1967	1967
78	1968	1968	1968
79	1969	1969	1969
80	1970	1970	1970
81	1971	1971	1971
82	1972	1972	1972
83	1973	1973	1973
84	1974	1974	1974
85	1975	1975	1975
86	1976	1976	1976
87	1977	1977	1977
88	1978	1978	1978
89	1979	1979	1979
90	1980	1980	1980
91	1981	1981	1981
92	1982	1982	1982
93	1983	1983	1983
94	1984	1984	1984
95	1985	1985	1985
96	1986	1986	1986
97	1987	1987	1987
98	1988	1988	1988
99	1989	1989	1989
100	1990	1990	1990

